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(54) Title: HIDDEN DOOR FOR AN AIR BAG RESTRAINT SYSTEM			
(57) Abstract			
<p>An air bag restraint system (10) is housed within an interior trim product with a hidden door (12) that is opened when an air bag (30) is inflated for deployment into the passenger car or a vehicle. The door (12) is formed in a reinforced segment (38) of a layer of a low density rigid foam material (34) that forms the load bearing support for the interior trim product and a backing for an outer skin or decorative outer surface that forms the outer cover (32) of the interior trim product. The hidden door (12) is formed by the layer of low density rigid foam material one of which convolutions (42, 44) forms a door hinge and the other of which convolutions (46) forms a weakened tear seam which separates when the air bag (30) impacts thereagainst to tear the outer skin (32) for forming an opening therethrough for deployment of the air bag (30) into the passenger compartment of a vehicle.</p>			

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HIDDEN DOOR FOR AN AIR BAG RESTRAINT SYSTEM

This is a continuation-in-part application of  
United States Serial No. 07/929,018, filed August 13,  
5 1992.

Field of the Invention

10 This invention relates to air bag restraint systems known as supplemental inflatable restraints and more particularly to such restraints which are housed in interior trim products of a motor vehicle by a hidden door assembly.

15 Background of the Invention

Various air bag restraint systems have been proposed in which an access door is arranged behind a continuously formed outer skin or cover. In some cases 20 the underside of the outer skin is perforated or weakened. As shown in United States Patent Nos. 3,622,176 and 4,246,213 the weakened sections represent underlying depressions in the outer cover which show through as an outline of the underlying air bag 25 assembly. Furthermore, such systems require that the outer cover be torn apart at the weakened seams. If the seams are irregular in form the opening force will vary and at times may tend to impede the release of an air bag.

30 In other arrangements, the cover assembly includes a separate cutting device that will pierce the outer skin. Examples of such separate devices are set-forth in United States Patent No. 4,097,064 and copending United States Applications 601,406 filed 35 October 22, 1990.

Other cover arrangements for air bag assemblies on the driver side steering wheel location

are shown in United States Patent Nos. 4,911,471 and 4,852,907 in which a layer of low density foam is reinforced by a layer of mesh. Such arrangements are configured for attachment to a base plate that is

- 5 connected by a bracket to the steering column of a vehicle. There is no provision for a separate layer of rigid foam material that is arranged to underlie and fully back a separate cover layer so as to form the load bearing support for an interior trim product such as an  
10 instrument panel having a hidden door formed therein. Rather, the cover forms a door that is directly attached to the sides of the air bag container structure.

Other air bag cover assemblies are shown in United States Patent Nos. 3,794,349; 4,120,516;

- 15 4,791,019; and 5,082,310. None of these patents show or suggest a air bag cover assembly having a hidden door in a larger interior trim product such as an instrument panel having a passenger side air bag assembly therein and wherein the load bearing support is a low density,  
20 rigid foam material located beneath an outer decorative layer and wherein the single load bearing support is formed of a low density material having a thickness and flexural modulus that in combination will produce a resultant door stiffness that will enable the hidden  
25 door to penetrate the outer decorative layer to form a deployment opening therethrough, e.g., the door has a stiffness great enough to fracture the materials defining the hidden tear seam.

30 Summary of the Invention

The present invention includes a cover assembly for an air bag restraint system which is easily fabricated using standard molding apparatus and which  
35 has a load bearing layer of low density rigid material that supports the outer cover of an interior trim product that extends laterally on all sides of a hidden

door assembly located beneath the surface of the outer cover and which further includes an integral hidden door operable on air bag inflation to form an opening in the outer cover for deployment of the inflated air bag into  
5 the passenger compartment of a motor vehicle.

A feature of the present invention is to form convolutions in the layer of low density rigid material which define a hinge and a weakened tear seam which will provide pivotal movement of a hidden door that will be  
10 engaged by the air bag during deployment and that will separate at the weakened tear seam formed in a layer of low density rigid foam material by means of a stiffness that enables the hidden door to fracture the low density foam material and the layer of decorative material  
15 defining the weakend tear seam.

Still another feature of the present invention is to provide a cover assembly for concealing an air bag restraint assembly including an air bag, a housing for the air bag, a gas generator located in the housing for  
20 supplying gas to the air bag in response to vehicle impact, the cover assembly comprising an outer skin covering an interior trim product within the vehicle and including a backing layer of low density rigid reaction injection mold material behind the outer skin for  
25 supporting the outer skin throughout its planar extent and wherein the backing layer has integrally formed hidden seams therein at least one of which is reinforced at a hidden door therein to form a hinge and wherein at least another of the convolutions forms a weakened tear  
30 segment which in one embodiment is formed of unreinforced low density rigid reaction injection mold material that will separate at the weakened tear seam and wherein the flexural modulus and the thickness of the low density rigid foam material produces a stiffness  
35 that enables the hidden door to break at the hidden seam and to fracture the cover layer to separate and fold back segments of the backing layer and outer skin to

form an opening therethrough for deployment of an air bag into the passenger compartment of a vehicle when inflated by the gas generator.

A still further feature of the present invention is to provide a cover assembly for concealing an air bag restraint assembly including an air bag, a housing for the air bag and a gas generator located in the housing for supplying gas to the air bag in response to vehicle impact, the cover assembly comprising: an outer skin covering an interior trim product within the vehicle and including a backing layer of reaction injection mold material having a density in the range of 5-60 pcf (pounds/ft<sup>3</sup>), in the range of 10-15 MPa; flexural modulus of 25,000 to 1,000,000 psi and a thickness greater than between 1.5mm and 10.0mm such that the backing layer of reaction injection mold material will have a stiffness that will fracture a hidden seam in the backing layer and to define a hidden door within the cover assembly and having convolutions formed on the inboard surface of the backing layer defining a hinge and a weakened tear section in the hidden door and wherein the tear section will separate to cause the door to penetrate both the backing layer and the outer skin to pierce and fold back segments of the backing layer and outer skin to form an opening therethrough for deployment of an air bag into the passenger compartment of a vehicle when inflated by the gas generator.

In the construction of soft foam insert doors a preformed outer skin or shell member formed by casting vinyl particles on a heated mold surface is seated in a female cavity of a foam mold as set-forth in United States Patent No. 4,784,336 and 4,873,032 which are commonly assigned to the assignee in the present application, and are incorporated herein by reference. A first substrate member is supported at construction holes on the lid of the mold which closes to form a mold

space between the substrate and the preload vinyl skin. The substrate on the lid can also include a port through which foam precursors are directed into the mold space for reaction therein to form a microcellular foam

5 material that is soft to the feel. The resultant structure is removed from the foam mold and includes a vinyl skin which can be colored and grained to match the aesthetic appearance of the outer vinyl surface of an interior trim product such as an instrument panel having

10 an upper opening therein for the deployment of an air bag. In the present invention there is no substrate and the skin is located in a mold cavity into which the RIM material is inserted in stages with it including reinforced precursors only when filling in the vicinity

15 of the hidden door part of the mold cavity. In the present invention the mold has a member with recesses therein which are configured to form the convolutions. The use of convolutions to form the hinge and weakened tear segment of the hidden door enable the door pattern

20 to assume many forms including rectangular, three sided U-shaped doors, weakened X sections or other geometries depending upon the type of interior trim product and supplemental inflatable restraint which are used in association with the invention.

25 Another embodiment of the invention configures the convolutions to form a weakened tear segment as a right angular opening that is spaced from the outer layer by less than 1mm and that fractures to form an eagle beak having an edge thereon that will penetrate  
30 the outer layer so as to form the opening therethrough for deployment of an air bag into the passenger compartment of a vehicle.

#### Brief Description of the Drawings

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Other advantages of the present invention will be readily appreciated as the same becomes better

understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a perspective view of an instrument panel or dashboard which is one suitable interior trim product for housing and providing an opening for deployment of an inflatable restraint into the passenger compartment of a motor vehicle;

FIG. 2 is an enlarged top elevational view of the instrument panel with a portion of an outer cover and its backing foam broken away to show the hidden door retainer of the present invention;

FIGS. 2A, 3A, 4A are top elevational views of other embodiments of the invention;

FIG. 3 is an enlarged sectional view of one embodiment of the invention taken along the line 3-3 of FIG. 2;

FIG. 4 is an enlarged sectional view like FIG. 3 but showing the retainer in a partially opened air bag deployment position;

FIG. 5 is an enlarged sectional view showing the retainer in a fully opened air bag deployment position;

FIG. 6 is an enlarged sectional view of another embodiment of the invention showing a fragmentary view of a hidden seam therein with an eagle beak thereon;

#### Description of Preferred Embodiment of the Invention

30

Referring now to FIG. 1, a door assembly for an opening through which an inflatable restraint safety device is deployed into a passenger compartment is shown at 10. In this embodiment of the invention the door assembly 10 is shown in a top mount position in which it defines a hidden door 12 formed beneath the top surface 14 of a dashboard or instrument panel 16. The door 12

has a front edge 12a located adjacent the front surface 16a of the instrument panel 16 and it includes a rear edge 12b located in underlying relationship to a sloped front windshield 18. While shown in the upper surface 5 of the instrument panel, the door could also be formed in the front surface 16a in what is known as a mid-mount position. The top mount or mid-mount of the door assembly 10 depends upon the location of an underlying air bag restraint system 20. In the illustrated 10 embodiment of FIG. 1, the air bag restraint system 20 includes a gas generator or canister 22 located in a canister housing or casing 24 mounted on a suitable vehicle component not shown. The gas generator has a plurality of openings 22a through which a suitable 15 inflatant gas flows when an impact sensor 26 is actuated upon vehicle impact to condition a controller 28 to initiate gas generation all as is well known to those skilled in the art. The inflatant is directed into the interior of an inflatable air bag 30 connected at one 20 end 30a to the casing 24 and having convolutions 30b which expand as the air bag is inflated to impact against the underside of the door assembly 10 to cause it to pivot upwardly toward the windshield 18 to allow 25 for deployment of the air bag 30 through the opening 12.

In accordance with the invention, the door assembly includes a vinyl outer cover 32 which can be formed from cast vinyl material by processes such as those set-forth in United States Patent Nos. 4,664,864 and 4,784,911, commonly assigned to the same assignee as 30 in the present application. Such outer covers 32 have colors and grain appearances that are accurately matched to the appearance of the surface of an associated interior trim product such as the illustrated instrument panel. The vinyl outer cover 32 is supported by a 35 backing layer of reinforced injection molded material forming a rigid substrate 34 in a foam mold apparatus such as illustrated and described in United States

Patent No. 4,806,094, commonly assigned to the same assignee as the present invention. In accordance with the present invention the substrate has a region 36 therein reinforced by suitable embedded material such as

5 glass fibers 38, scrim PVC coated nylon as manufactured by Luckenhaus Corporation or other suitable reinforcing material to form the hidden door 12. The RIM foam system is shot into a mold cavity directly behind the grained outer cover 32 which can be polyvinyl chloride

10 (PVC) or acrylonitrile-styrene-acrylic (ABS) vacuum formed with or without a layer of soft foam or alternatively the outer cover 32 can be a cast dry plastisol material or liquid cast plastisol PVC or cast dry plastisol with an expanded thickness for providing

15 a soft feel.

The outer cover 32 will be supported by the backing layer or rigid substrate 34 to match the styling and appearance of a foamed interior trim product. The rigid substrate 34 is a backing layer of reaction

20 injection material such as ICI 8709B and ICI 8700A urethane foam supplied by ICI Americas Inc. In a representative embodiment stiffness of the rigid substrate, formed with one layer of fiber glass mat is illustrated by the following diagrams:

COMPETITIVE ANALYSIS

		<u>DITT<sup>1</sup></u> <u>FN-10 O/P</u>	<u>Inland</u> <u>Buick C D/P</u>	<u>Lustran</u> <u>246 ABS</u>	<u>ASTM</u> <u>Test</u>
5	Density Mean St. Dev.	.38 .02	.70 .01	1.07	D-3574 <sup>2</sup>
10	Density #/cubic ft.	24	42	40	
	Thickness, mm	4.65	2.67	2.5	--
15	Ash, %	16.4 1.2	14.9 .9	--	--
	Flexural Modulus, MPa	641 46	640 143	2700	D-790
20	Tensile Strength, MPa (@ max load) (at room temp.)	12.9 1.0	22.8 5.5	33	D-638
25	Elongation, % (@ break) (at room temp.)	1.9 0.4	2.7 .4	--	D-638
30	Hardness	87.8 1.5	--	113 (Rockwell R)	D-2240
	Water Absorption, %	2.8	2.3	--	D-570
35	Flammability, mm/min	SE/NBR	SE/NBR	--	MVSS 302
	PTL#	#10307 #10308	#10149	published data	

COMPETITIVE ANALYSIS (Continued)

		DITT <sup>1</sup> <u>FN-10 Q/P</u>	Inland <u>Buick C D/P</u>	Lustran <u>246 ABS</u>	ASTM <u>Test</u>
5	Instrumented impact, (5.4 KS kg hammer 787mm drop height) Energy to Break, J				D-3763
10	023 °C	11.0 .7	7.1 3.5	16.8	
	Izod Impact, J/M (notched)	154.3 51.8	--	267	D-256
15	Heat Sag, mm (127mm overhang 1 hr. @ 121°C)	No Change	3.0 1.7	--	--
20	HDT, °C 0.45 MPa	120.8 10.4	--	93	D-648
25	01.82 MPa	75.1 5.6	--	87	
	CLTE mm/mm/°C (x10 <sup>5</sup> )	1.6	1.5	8.3	D-696
30	PTL#	#10307 #10308	#10149	#10077 published data	

In accordance with one feature of the present invention, the substrate 34 is formed with two spaced side sections 40, 41 and spaced convolutions 42, 44 on the inboard surface 34a thereof. The convolutions 42, 44 form reduced sections in the hidden door 12 that define two spaced hinges for movement of door segments 12a, 12b into an upwardly pivoted position when an intermediate weakened tear seam defined by a convolution 46 formed intermediate the hinges 42, 44 in an inboard air bag impact surface 48.

The hidden door's side sections are recesses 40, 41 forming weakened sections at the sides of the door segments 12a, 12b. The weakened tear seams defined by the side recesses 40, 41 and the intermediate 5 convolution 46 are not reinforced by the glass fibers 38. Accordingly, when the air bag is inflated as shown in FIG. 4, the convolution 46 will separate to tear the cover 32 to allow the two door segments 12a, 12b to pivot upwardly about the convolutions 42, 44 forming the 10 hinges. When the door segments 12a, 12b are fully vertical the convolutions 42, 44 form curved relief surfaces for smoothing the deployment of the air bag into the passenger compartment. Specifically, when the embedded material is PVC coated nylon, the mat should 15 extend 3 to 6 inches beyond the outer door edges and should include slits or cuts to match the weakened tear seams in the rigid RIM foam.

In all cases, deployment of an air bag causes it to impact the inside surface of the retainer 34 to 20 force the door segments 12a, 12b upwardly and outwardly so as to produce an opening orange peel type action until the overlying cover material is fully peeled back to define an opening more or less congruent with the outline of the weakened segments in the retainer. Since 25 the hinges and weakened tear segments are defined by recesses or convolutions on the inboard surface of the retainer or substrate 34, the hidden door 12 is completely invisible at the outer surface of the

interior trim product. The door pattern is easily varied from the rectangular form to a three sided U form (at 50 in FIG. 2A) or to an X section (at 60 in FIG. 3A) or an H section (at 70 in FIG. 4A) merely by changing 5 the location of the convolutions on the underside of the substrate 34.

The invention provides considerable design freedom since the depth of the convolutions and resulting hinge and tear seam sections can vary greatly 10 without being observable from the outer surface of the cover or without adversely affecting the surface quality of the interior trim product.

The door assembly of the subject invention thereby provides a soft skin door that is easily matched 15 to adjacent interior trim products having foamed in place material and wherein the door assembly can be formed by standard foam molding apparatus without requiring special modifications to substrate components or without modification of the lid for carrying such 20 substrates and wherein a substrate has a rigidity and low density and weakened sections that are invisible from the exterior of an interior trim product so that a passenger is unaware of the underlying air bag restraint system. While the invention is shown in association with 25 a dashboard or instrument panel it is equally suitable for use with other interior trim products such as driver side steering wheel housings. The arrangement is manufactured not only with standard equipment practicing

standard steps it enables the door to be used with less steps and in a more cost effective manner than the assemblies in the prior art.

As shown in the aforesaid comparative analysis 5 and in Figure 4, the substrate 34 is the load bearing support in the assembly. It is a low density material that has a thickness in the range of 4.00mm to 10mm and a tensile strength in the range of 10-15 MPa.

These thickness and strength properties 10 combine to produce a stiffness in the hidden door 12 that will cause the convolutions 46 to break and penetrate the decorative outer surface defined by cover 32.

In the embodiment of Figure 6, the 15 convolutions are formed as a right angle notch 50 that defines a weakened tear seam in a hidden door 12' at a substrate 34'. A hinge notch 52 is bridged by a layer of glass reinforcement 53. The notch 50 terminates at an "eagle beak" 54 that is spaced from an outer 20 decorative surface 56 and extends along the length of an H, U or X tear seam. The surface 56 is shown as a layer of cast polyvinyl chloride 56a and a layer of expanded polyvinyl chloride 56b for softness. The surface 56 is not cut or notched. The stiffness of hidden door 12 is 25 like that in the previous embodiment and is attributable to like strength and thickness properties. In the embodiment of FIG. 6, the substrate 34' is a rigid urethane that is 10mm thick. The eagle beak 54 is

separated from the surface 56 by a spacing 57 of 1mm. The PVC layer is .9mm and the expanded PVC is 2mm. A spray adhesive is provided between the surface 56 and substrate 34'.

5           The invention has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation.

10           Obviously, many modifications and variations of the present invention in light of the above teachings may be made. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically  
15           described.

**What is claimed is:**

1. An invisible door assembly for a supplemental inflatable restraint device housed within  
5 an interior trim product of a motor vehicle comprising an outer skin cover formed as the outer skin of the interior trim product;  
  
a layer of low density rigid material bonded to said outer cover having a hidden door therein;  
10 means embedded in said low density rigid material for reinforcing it only in the vicinity of said hidden door; said hidden door having an inboard impact surface including first and second convolutions therein; one of said convolutions forming a hinge and the other of said  
15 convolutions forming a hidden tear segment formed in said inboard impact surface;  
  
said hidden tear segment being unreinforced and having lesser strength than said hinge;  
  
said layer of low density rigid material  
20 overlying an inflatable air bag; means including a canister for locating said air bag to be deployed against the inboard surface of said layer of low density rigid material for imposing a force on said hidden tear seam segment for causing it to separate to form an  
25 opening through said cover for deployment of an inflated air bag into the passenger compartment of a motor vehicle.

2. An invisible door assembly for a supplemental inflatable restraint device housed within an interior trim product of a motor vehicle the motor vehicle having an outer skin cover for a substrate and  
5 a hidden door assembly and said outer skin cover having an outer surface and an inner surface comprising: said substrate comprising a layer of low density rigid foam material having an outer surface engaging said inner surface of said outer skin cover for supporting said outer skin cover within the motor vehicle; said hidden door formed integrally of said substrate and having an inner surface with an impact portion and an integrally formed hinge segment on one side of said impact portion;  
10 said hidden door further including a hidden tear  
15 segment;

said hidden door overlying an inflatable air bag; means including a canister for locating said air bag to be deployed against the impact portion of said layer of low density rigid foam material for  
20 imposing a force on the hidden tear segment; said low density rigid foam material having a thickness greater than 4mm and a tensile strength less than 15 MPa, for causing said hidden tear segment to separate and penetrate through said cover to form an opening through  
25 said cover for deployment of an inflated air bag into the passenger compartment of a motor vehicle.

3. An invisible door assembly for a supplemental inflatable restraint device housed within an interior trim product of a motor vehicle comprising an outer skin cover for a substrate and a hidden door assembly; said outer skin cover having an outer surface and an inner surface; said substrate comprising a layer of low density rigid foam material having an outer surface engaging said inner surface of said outer skin cover for supporting said outer skin cover within the motor vehicle; said substrate having an inner surface with an impact portion and an integrally formed hinge segment on one side of said impact portion; said substrate further including a hidden tear segment; means for reinforcing said substrate at said impact portion and said integrally formed hinge segment to have a greater strength than the remainder of said substrate;

said low density rigid foam material having a thickness greater than 4mm and a tensile strength less than 15 MPa.

4. An invisible door assembly for a supplemental inflatable restraint device housed within an interior trim product of a motor vehicle comprising an outer skin cover formed as the outer skin of the interior trim product;

a layer of low density rigid material backing said outer cover having an inboard impact surface and first and second hinge segments formed

integrally of said low density rigid material on either side of said inboard impact surface and a hidden tear seam segment formed in said inboard impact surface intermediate said first and second hinge segments;

5                 said low density rigid foam material having a thickness greater than 4mm and a tensile strength less than 15 MPa.

5.         An invisible door assembly for a  
10         supplemental inflatable restraint device housed within an interior trim product of a motor vehicle comprising an outer skin cover formed as the outer skin of the interior trim product;

               a layer of low density rigid material  
15         backing said outer cover having an inboard impact surface including first and second convolutions therein; one of said convolutions forming a hinge and the other of said convolutions forming a hidden tear seam segment formed in said inboard impact surface;

20         said low density rigid foam material having a thickness greater than 4mm and a tensile strength less than 15 MPa;

               said layer of low density rigid material overlying an inflatable air bag; means including a  
25         canister for locating said air bag to be deployed against the inboard surface of said layer of low density rigid material for imposing a force on the hidden tear seam segment for causing it to separate to form an

opening through said cover for deployment of an inflated air bag into the passenger compartment of a motor vehicle.

5                 6. An invisible door assembly for a supplemental inflatable restraint device housed within an interior trim product of a motor vehicle comprising an outer skin cover formed as the outer skin of the interior trim product;

10                 a layer of low density rigid material bonded to said outer cover having an inboard impact surface; means including first and second convolutions in said layer forming a hidden door of generally rectangular configuration in said layer of low density  
15                 rigid material; one of said convolutions forming a hinge on said door and the other of said convolutions forming a hidden tear seam segment formed in said inboard impact surface;

20                 said low density rigid foam material having a thickness greater than 4mm and a tensile strength less than 15 MPa;

25                 said layer of low density rigid material overlying an inflatable air bag; means including a canister for locating said air bag to be deployed against the inboard surface of said layer of low density rigid material for imposing a force on the hidden tear seam segment for causing it to separate and to cause said door to pivot about said hinge to form an opening

through said cover for deployment of an inflated air bag into the passenger compartment of a motor vehicle.

7. An invisible door assembly for a  
5 supplemental inflatable restraint device housed within  
an interior trim product of a motor vehicle comprising  
an outer skin cover formed as the outer skin of the  
interior trim product;

a layer of low density rigid material  
10 backing said outer cover having an inboard impact  
surface and convolutions defining a three sided hidden  
door with a hinged end; one of said convolutions forming  
said hinge and the other of said convolutions forming a  
hidden tear segment; said hinge and hidden tear segment  
15 formed in said inboard impact surface;

said low density rigid foam material  
having a thickness greater than 4mm and a tensile  
strength less than 15 MPa;

said layer of low density rigid material  
20 overlying an inflatable air bag; means including a  
canister for locating said air bag to be deployed  
against the inboard surface of said layer of low density  
rigid material for imposing a force on the hidden tear  
segment for causing it to separate and for causing said  
25 door to pivot about said hinge to form an opening  
through said cover for deployment of an inflated air bag  
into the passenger compartment of a motor vehicle.

8. An invisible door assembly for a supplemental inflatable restraint device housed within an interior trim product of a motor vehicle comprising an outer skin cover formed as the outer skin of the  
5 interior trim product;

a layer of low density rigid material backing said outer cover having a hidden door therein; means embedded in said low density rigid material for reinforcing it only in the vicinity of said hidden door;  
10 said hidden door having an inboard impact surface including first and second convolutions therein; one of said convolutions forming a hinge and the other of said convolutions forming a hidden tear segment formed in said inboard impact surface;

15 said low density rigid foam material having a thickness greater than 4mm and a tensile strength less than 15 MPa;

said layer of low density rigid material overlying an inflatable air bag; means including a  
20 canister for locating said air bag to be deployed against the inboard surface of said layer of low density rigid material for imposing a force on the hidden tear seam segment for causing it to separate to form an opening through said cover for deployment of an inflated  
25 air bag into the passenger compartment of a motor vehicle.

9. An invisible door assembly for a supplemental inflatable restraint device housed within an interior trim product of a motor vehicle comprising an outer skin cover formed as the outer skin of the 5 interior trim product and having a hidden tear seam and a layer of low density rigid foam material substrate;

said low density rigid foam material having a thickness greater than 1.5mm and less than 12mm and a flexural modulus less than 1,000,000 psi and 10 greater than 25,000 psi to produce a stiffness for causing said hidden tear seam to separate to form an opening through said outer skin cover for deployment of an inflated air bag into the passenger compartment of a motor vehicle.

15

10. The invisible door assembly of claim 1 further comprising said low density rigid material having a thickness greater than 10mm and said weakened tear seam comprising a notch having an acute angle 20 cross-section for forming an eagle beak in said substrate; said eagle beak having an edge spaced from said outer cover less than 1.5mm; said edge, upon separation of said hidden tear seam segment penetrating said cover upon separation of said hidden tear seam 25 segment to form an opening therethrough during deployment of the inflated air bag into the passenger compartment of a motor vehicle.

11. The invisible door assembly of claim 9  
further comprising said substrate having a thickness  
greater than 10mm and said weakened tear seam comprising  
a notch having an acute angle cross-section for forming  
5 an eagle beak in said substrate; said eagle beak having  
an edge spaced from said outer cover less than 1.5mm;  
said edge, upon separation of said hidden tear seam  
segment penetrating said cover to form an opening  
therethrough during deployment of the inflated air bag  
10 into the passenger compartment of a motor vehicle.

**AMENDED CLAIMS**

[received by the International Bureau on 20 June 1995 (20.06.95);  
original claims 1-11 replaced by amended claims 1-5 (4 pages)]

1. An invisible door assembly for a supplemental inflatable restraint device housed within an interior trim product of a motor vehicle comprising  
an outer skin cover formed as the outer skin of the interior trim product;  
a layer of low density rigid material bonded to said outer cover having a hidden door therein;  
said hidden door having an inboard impact surface including a hinge region bridged by a reinforcement and a hidden tear seam segment formed in said inboard impact surface;  
said hidden tear seam segment being unreinforced and having lesser strength than said hinge region;  
said layer of low density rigid material overlying an inflatable air bag; and  
means for imposing a force to deploy said air bag against the inboard surface of said layer of low density rigid material and on said hidden tear seam segment whereby said tear segment separates, forcing said low density rigid material layer through said cover to form an opening for deployment of an inflated air bag into the passenger compartment of a motor vehicle.

2. An invisible door assembly as set forth in  
claim 1 wherein said layer of low density rigid material  
has a density in the range of 5-60 pcf (pounds/ft<sup>3</sup>),  
tensile strength in the range of 10-15 MPa, flexural  
modulus of 172 to 6890 MPa, and a thickness between  
5 1.5mm and 10.0mm.

3. An invisible door assembly as set forth in  
claim 1 wherein said hidden unreinforced tear segment  
has a configuration wherein a first side wall of said  
tear segment is generally perpendicular to said outer  
cover and a second sidewall of said tear segment meets  
5 said first sidewall to form an acute angle configuration  
spaced from said outer cover.

4. An invisible door assembly for a supplemental  
inflatable restraint device housed within an interior  
trim product of a motor vehicle comprising  
an outer skin cover formed as the outer skin of the  
5 interior trim product;  
a layer of low density rigid material having a  
density in the range of 5-60 pcf (pounds/ft<sup>3</sup>), tensile  
strength in the range of 10-15 MPa, flexural modulus of  
25,000 to 1,000,000 psi and a thickness between 1.5mm  
10 and 10.0mm, bonded to said outer cover having a hidden  
door therein;

said hidden door having an inboard impact surface including a hinge region and a hidden tear seam segment formed in said inboard impact surface;

15       said layer of low density rigid material overlying an inflatable air bag; and

means for imposing a force to deploy said air bag against the inboard surface of said layer of low density rigid material and on said hidden tear seam segment

20       whereby said tear segment separates, forcing said low density rigid material layer through said cover to form an opening for deployment of an inflated air bag into the passenger compartment of a motor vehicle.

5. An invisible door assembly for a supplemental inflatable restraint device housed within an interior trim product of a motor vehicle comprising

an outer skin cover formed as the outer skin of the  
5       interior trim product;

a layer of low density rigid material bonded to  
said outer cover having a hidden door therein;

10       said hidden door having an inboard impact surface including a hinge region and a hidden tear segment formed in said inboard impact surface;

      said hidden tear segment has a configuration wherein a first side wall of said tear segment is generally perpendicular to said outer cover and a second

15      sidewall of said tear segment meets said first sidewall  
to form an acute angle configuration spaced from said  
outer cover;

      said layer of low density rigid material overlying  
an inflatable air bag; and

20      means for imposing a force to deploy said air bag  
against the inboard surface of said layer of low density  
rigid material and on said hidden tear seam segment  
whereby said tear segment separates, forcing said low  
density rigid material layer through said cover to form  
an opening for deployment of an inflated air bag into  
25      the passenger compartment of a motor vehicle.

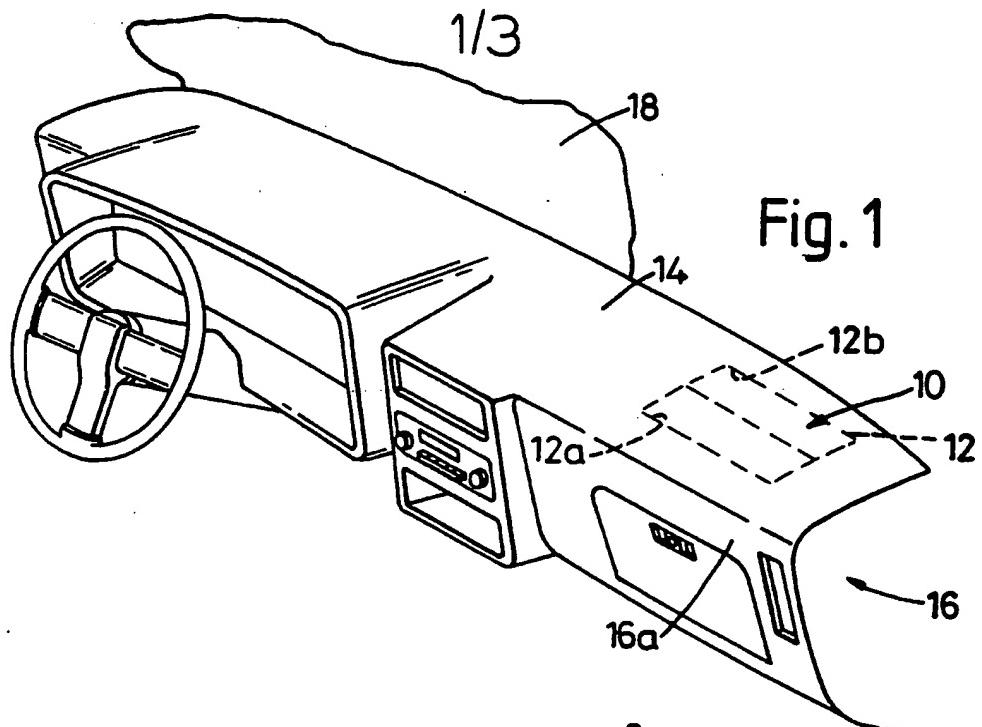


Fig. 1

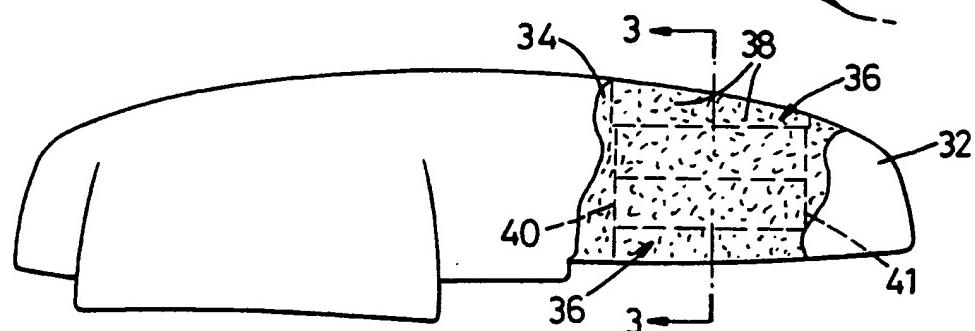


Fig. 2

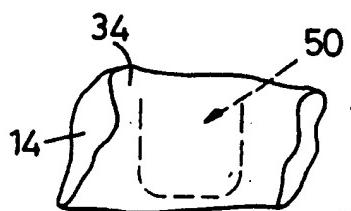


Fig. 2A

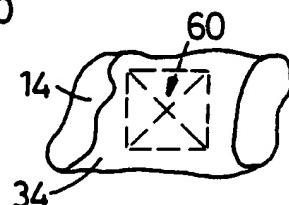


Fig. 2B

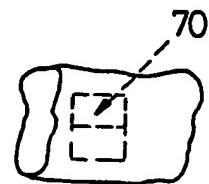


Fig. 2C

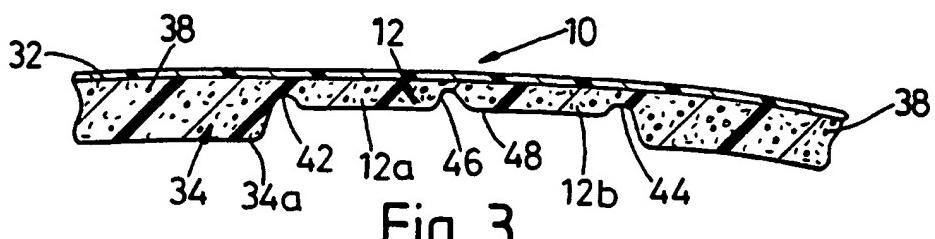


Fig. 3

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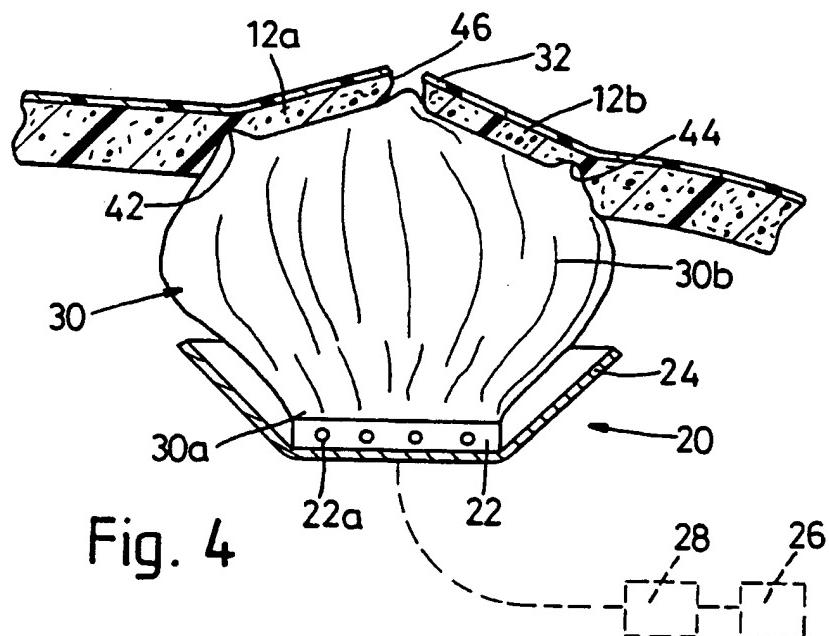


Fig. 4

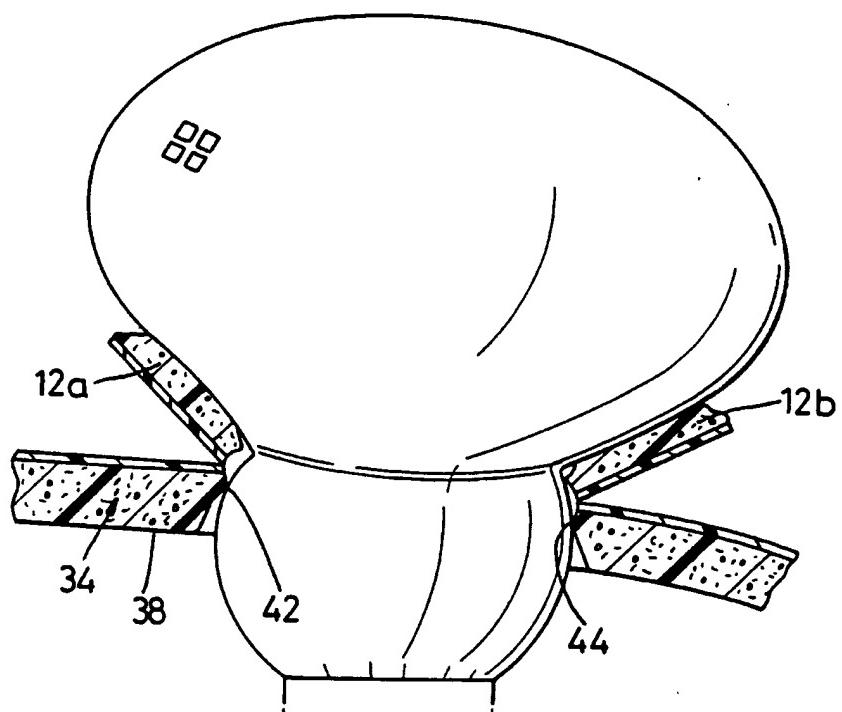


Fig. 5

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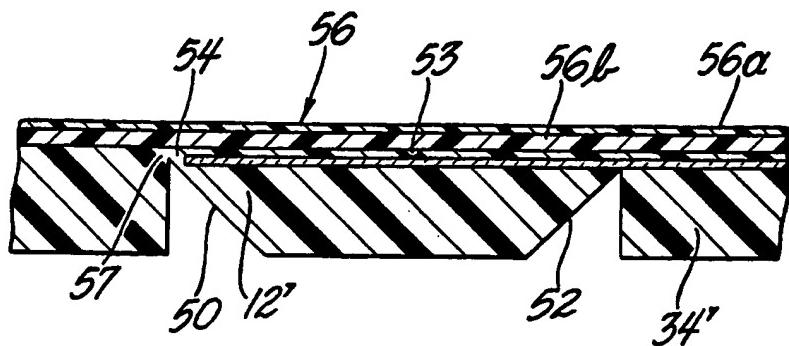


Fig. 6

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US95/01403

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) :B60R 21/20, 21/045  
US CL :280/728B, 732, 752; 264/45.3; 428/317.9

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 280/728B, 732, 728R, 752; 264/45.3; 428/317.9

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,911,471 (HIRABAYASHI ET AL) 27 MARCH 1990, col. 2, line 33 to col. 3, line 40.	1 and 5-11
Y	US, A, 5,082,310 (BAUER) 21 JANUARY 1992, col. 2, lines 13-60.	1-11
Y	US, A, 4,120,516 (TAKAMATSU ET AL) 17 October 1978, col. 2, line 55 - col. 3, line 25.	1-4 and 9-11
Y	US, A, 5,158,322 (SUN) 27 October 1992, col. 9, Table 3.	2-8
A	US, A, 4,791,019 (Ohta et al) 13 December 1988.	1-11

Further documents are listed in the continuation of Box C.  See patent family annex.

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*E* earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means		
*P* document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
13 APRIL 1995	20 APR 1995
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer <i>Karen Tyson</i> KARIN TYSON Telephone No. (703) 308-2086

**INTERNATIONAL SEARCH REPORT**International application No.  
PCT/US95/01403**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 5,393,089 (PAKULSKY ET AL.) 28 February 1995.	1-11